

# Deployable Propulsion and Power Systems for Solar System Exploration

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NASA is developing thin-film based, deployable propulsion, power and communication systems for small spacecraft that could provide a revolutionary new capability allowing small spacecraft exploration of the solar system.

The Near Earth Asteroid (NEA) Scout reconnaissance mission will demonstrate solar sail propulsion on a 6U CubeSat interplanetary spacecraft and lay the groundwork for their future use in deep space science and exploration missions. Solar sails use sunlight to propel vehicles through space by reflecting solar photons from a large, mirror-like sail made of a lightweight, highly reflective material. This continuous photon pressure provides propellantless thrust, allowing for very high  $\Delta V$  maneuvers on long-duration, deep space exploration. Since reflected light produces thrust, solar sails require no onboard propellant.

The Lightweight Integrated Solar Array and Transceiver (LISA-T) is a launch stowed, orbit deployed array on which thin-film photovoltaic and antenna elements are embedded. Inherently, small satellites are limited in surface area, volume, and mass allocation; driving competition between power, communications, and GN&C (guidance navigation and control) subsystems. This restricts payload capability and limits the value of these low-cost satellites. LISA-T is addressing this issue, deploying large-area arrays from a reduced volume and mass envelope – greatly enhancing power generation and communications capabilities of small spacecraft.

The NEA Scout mission, funded by NASA's Advanced Exploration Systems Program and managed by NASA MSFC, will use the solar sail as its primary propulsion system, allowing it to survey and image one or more NEA's of interest for possible future human exploration. *NEA Scout* uses a 6U cubesat (to be provided by NASA's Jet Propulsion Laboratory), an 86 m<sup>2</sup> solar sail and will weigh less than 12 kilograms. NEA Scout will be launched on the first flight of the Space Launch System in 2018.

Similar in concept to the NEA Scout solar sail, the LISA-T array is designed to fit into a very small volume and provide abundant power and omnidirectional communications in just about any deployment configuration. The technology is being proposed for flight validation as early as 2019 in a low earth orbit demonstration using a 3U cubesat, of which less than 1U will be devoted to the LISA-T power and propulsion system.

By leveraging recent advancements in thin films, photovoltaics and miniaturized electronics, new mission-level capabilities will be enabled aboard lower-cost small spacecraft instead of their more expensive, traditional counterparts, enabling a new generation of frequent, inexpensive deep space missions.

